Armed Forces College of Medicine

AFCM

Structure of Antibodies

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Humoral immune response

By the end of this lecture the student will be able to:

1-Outline series of reactions and functions of humoral immunity

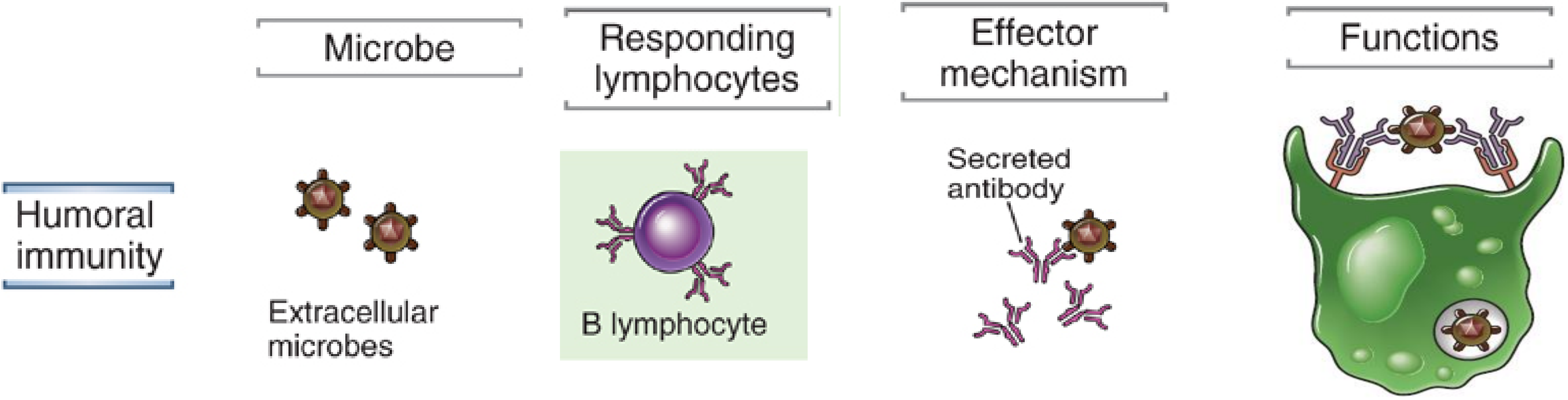
2-Relate each part of immunoglobulin (antibody) molecule to its function

3-Discuss steps of development of B lymphocytes in bone marrow.

HUMORAL IMMUNE RESPONSE

Mediated by **Antibodies (Abs) or Immunoglobulins (Igs)** produced by **activated B cells** (**plasma** cells)

Eliminate **extracellular** microbes & their toxins



Opsonization

Immunoglobulins

Site

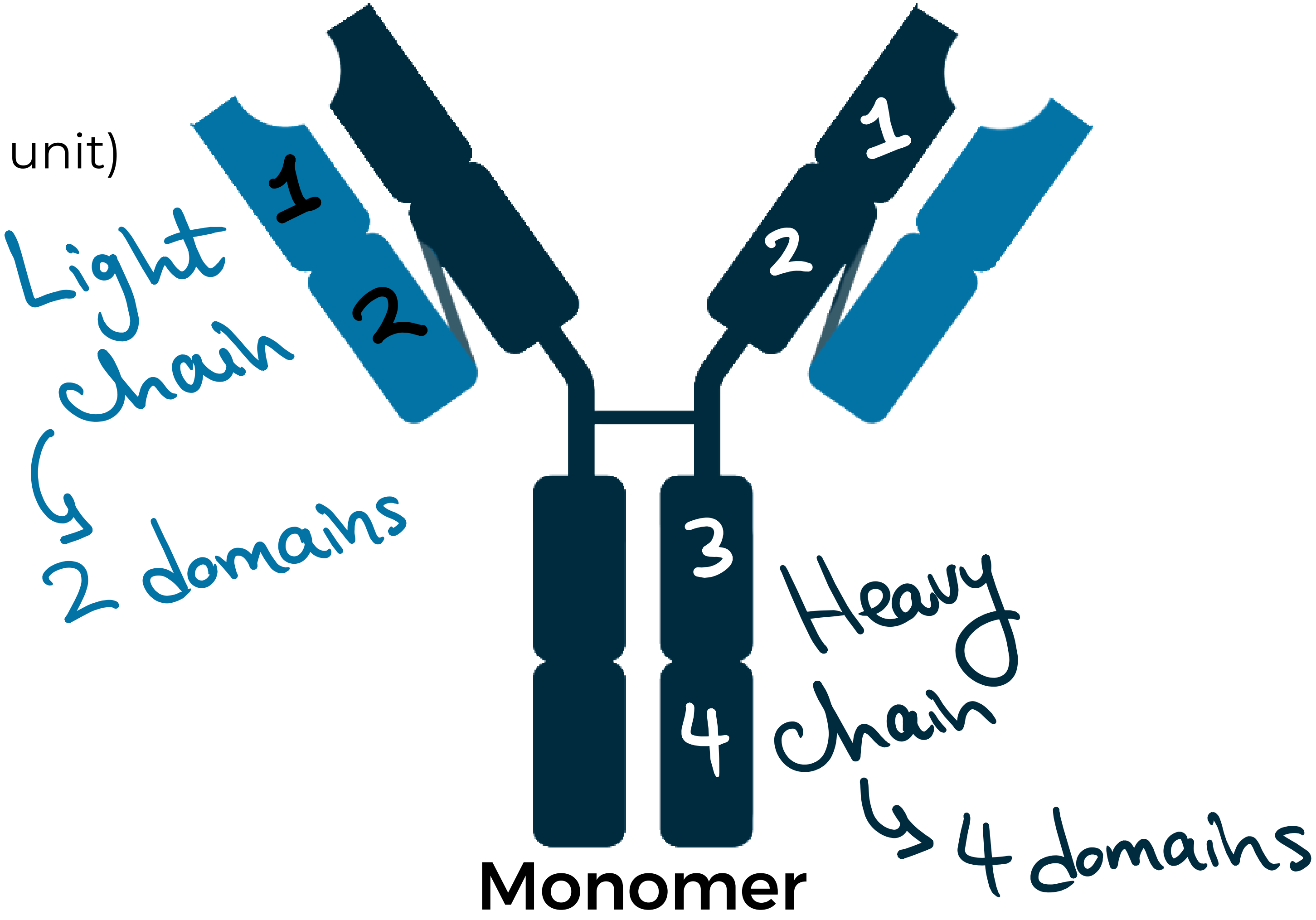
- Found in **all body fluids (humors)**

Structure

- Each Ab molecule (monomer or basic unit) is **Y shape**
- Formed of **4 polypeptide chains**

2 identical heavy (H) chains, each contains 4 domains

2 identical light (L) chains , each contains 2 domains



Monomer

Immunoglobulins

Structure

- Arranged in **3 fragments**:

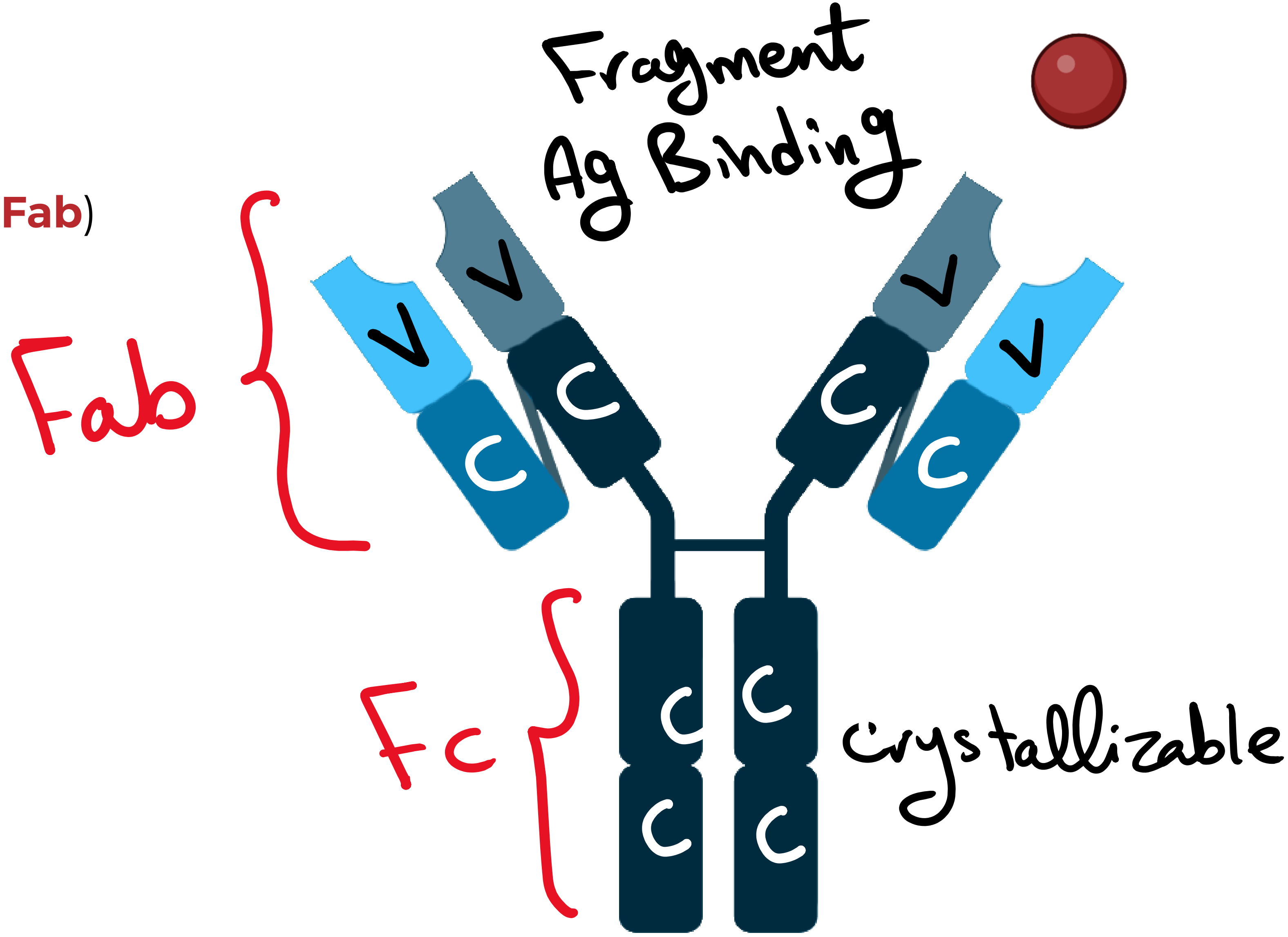
  2 Identical Ag binding sites (**2 Fab**)

  & 1 crystallizable (**Fc**)

- Each chain is formed of :

  Variable (V) region

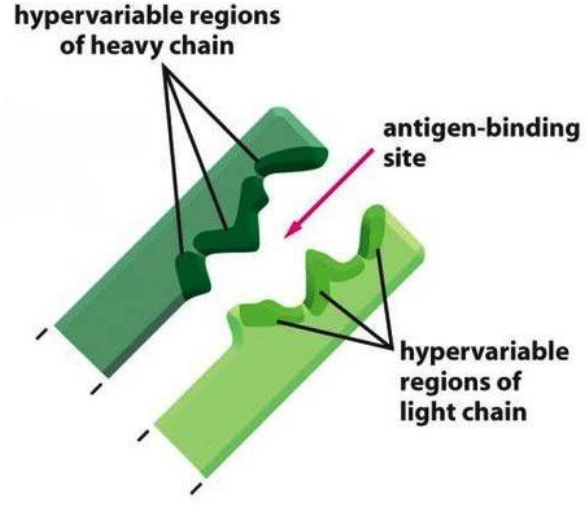
  & **Constant (C) region**



Immunoglobulins

Heavy & light chains

Variable region (in Fab)


hypervariable regions of heavy chain
antigen-binding site
hypervariable regions of light chain

1 domain of **Heavy (H) chain (VH)** & **1** domain of **Light (L) chains (VL)**

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Forms the **paratope of Ab**

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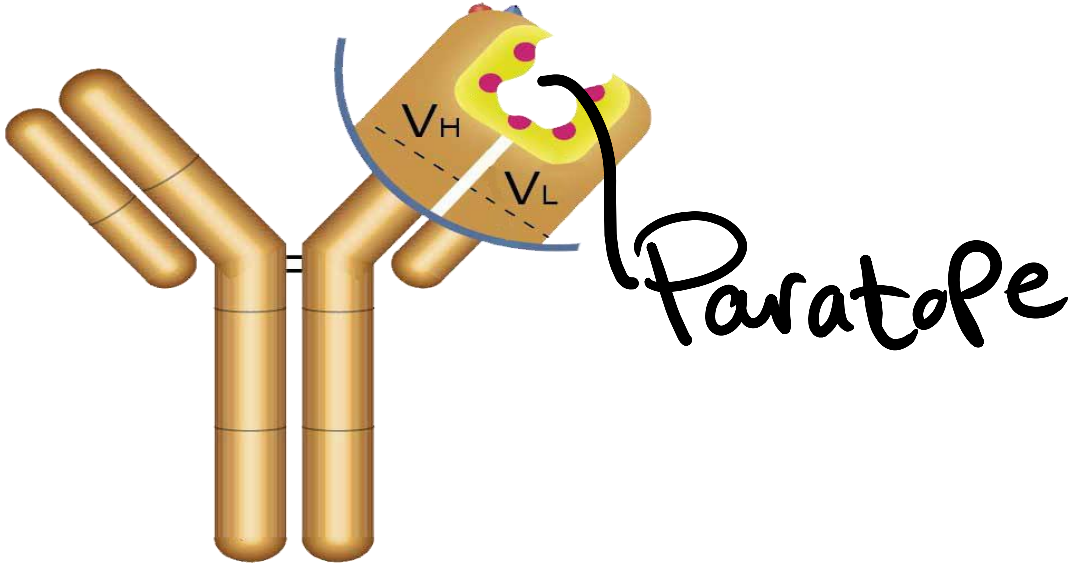
Interacts specifically with the **epitope of Ag** (complementary to it)

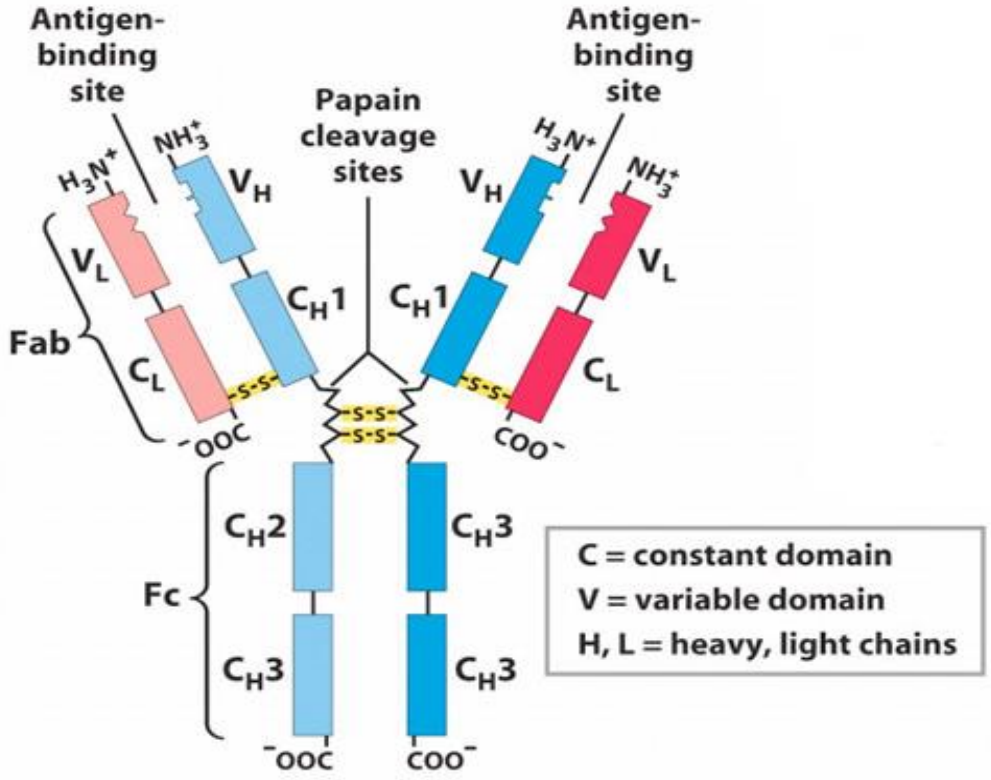


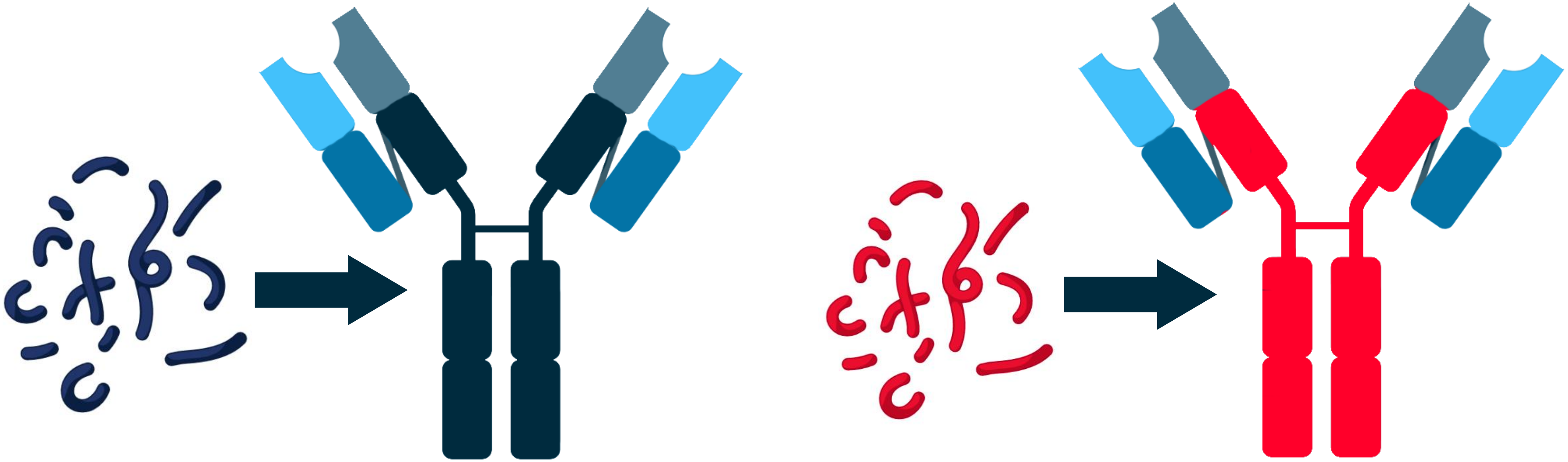
Constant region of Heavy chain

Structure 3 domains CH1, CH2 ,CH3

Types

There are 5 isotypes (classes) of Igs that differ in constant region (CH) of heavy chain





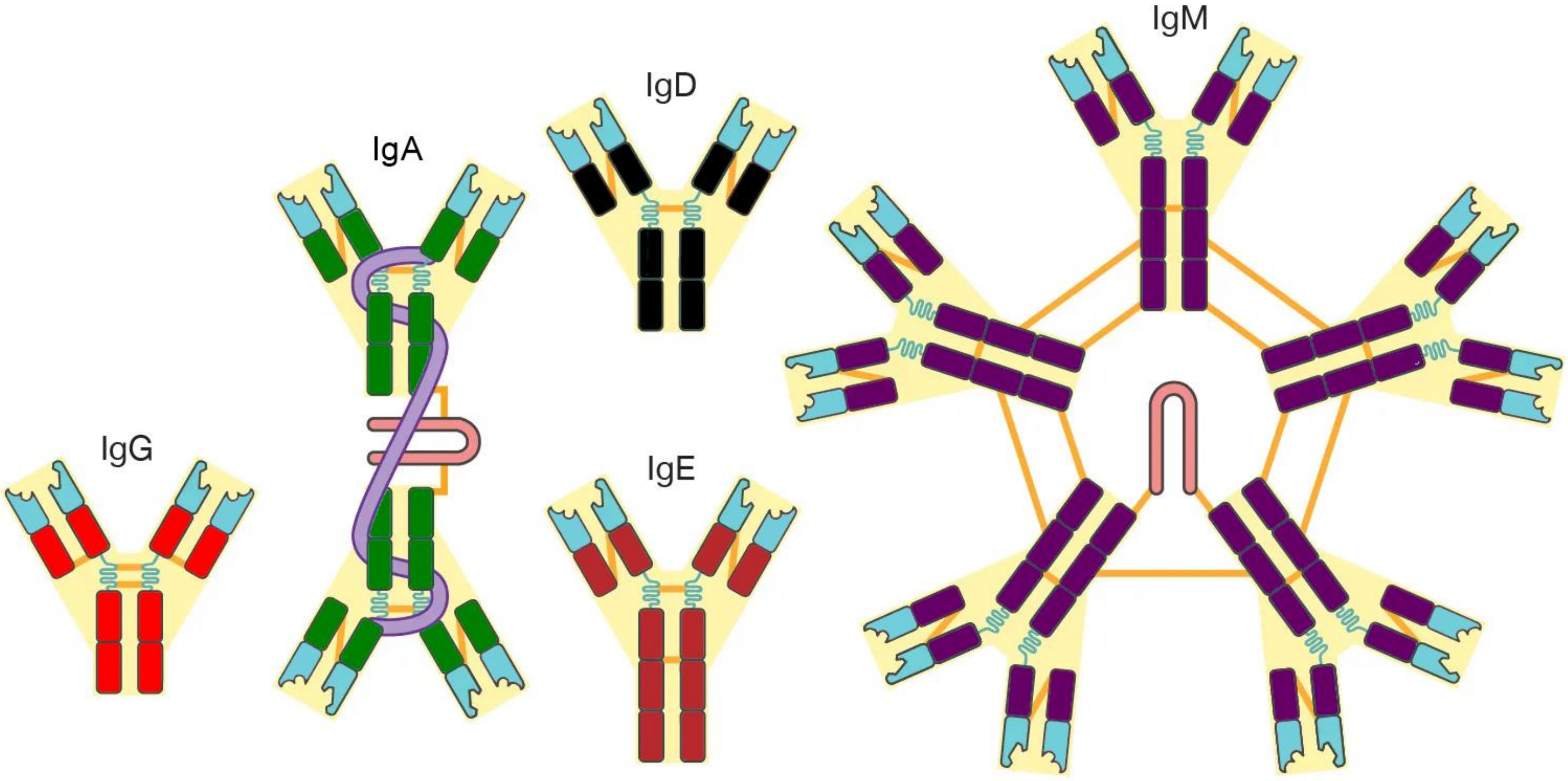
Constant region of Heavy chain

Structure **3 domains** CH1, CH2 ,CH3

Types

There are 5 classes (isotypes) of Igs that differ in constant region (CH) of heavy chain

1) **Gamma** (γ) chain → Ig **G**
2) **Alpha** (α) chain → Ig **A**
3) **Mu** (μ) chain → Ig **M**
4) **Epsilon** (ε) chain → Ig **E**
5) **Delta** (δ) chain → Ig **D**



Constant region of Heavy chain

The 5 classes differ in functions

Function

- **Contains Fc which is responsible for biological (effector) functions of Ig e.g**

  Binding to receptors (Fc R) on immune cells e.g Phagocytic cells → **Opsonization**

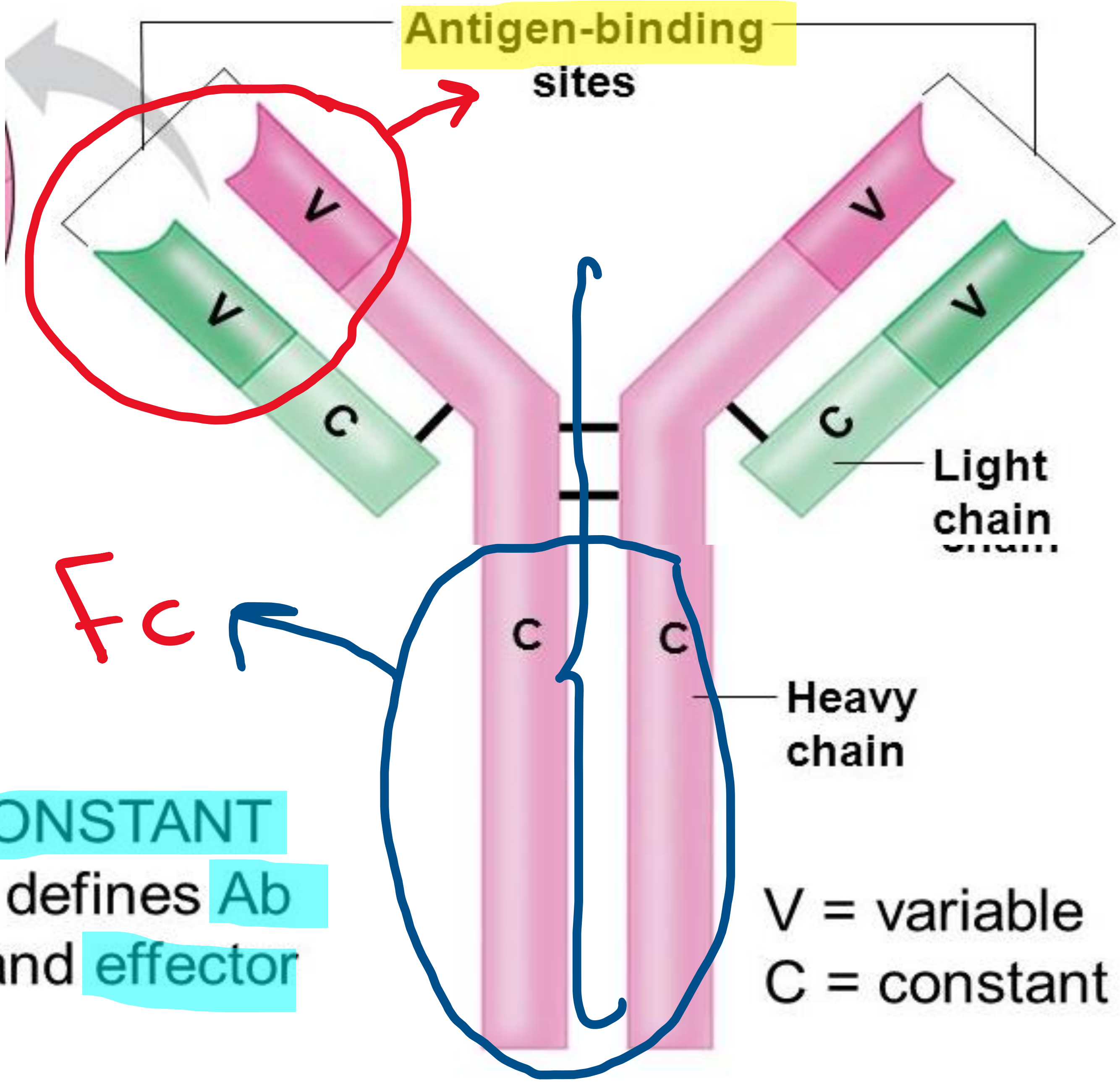
- **Fc fragment differs** in the 5 isotypes (classes)

  ➥The 5 classes have **different biological functions**

The plasma cell of each B cell clone must

produce the 5 classes of Abs

against its specific Ag



The CONSTANT region defines Ab class and effector action

V = variable
C = constant

B lymphocytes

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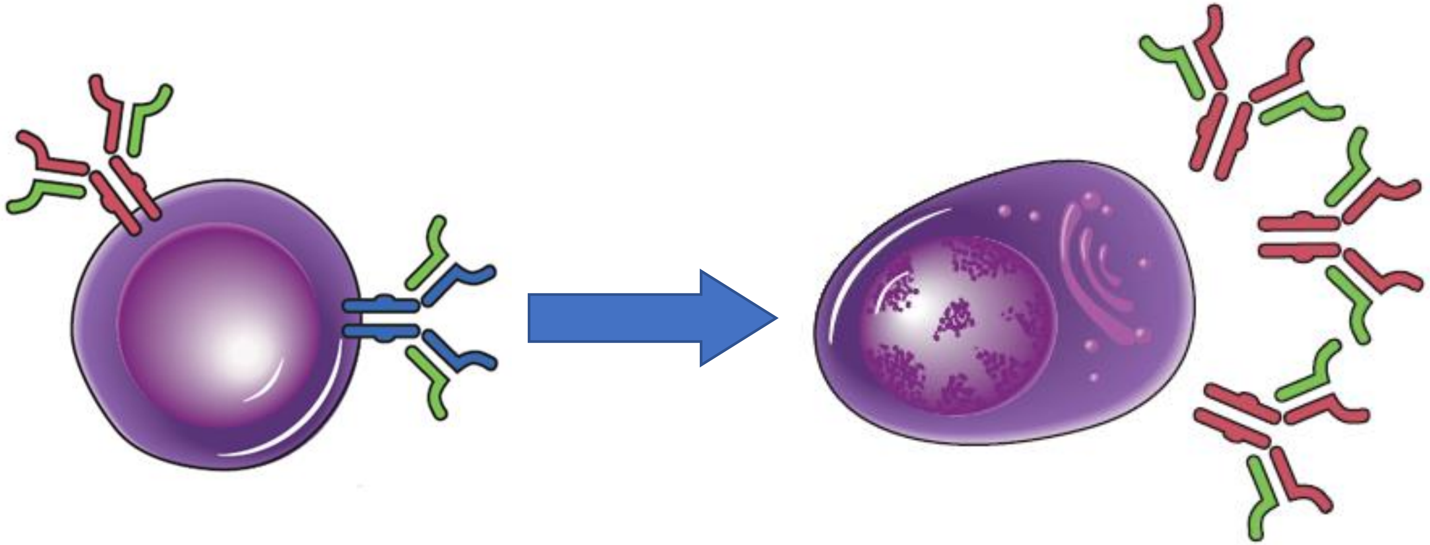
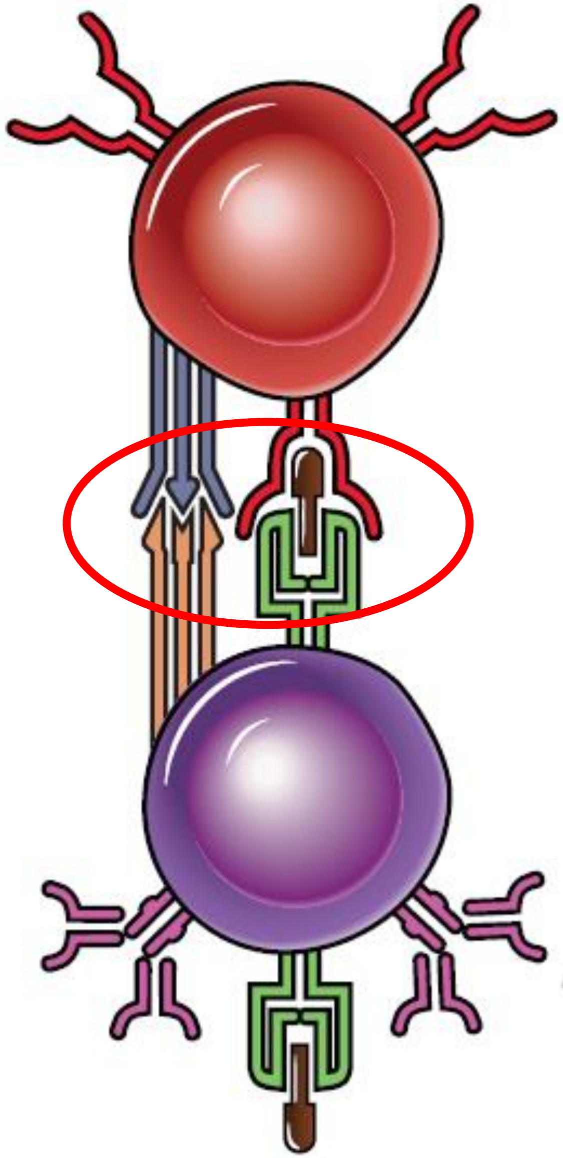
B lymphocytes

Functions

- Responsible for **humoral immune response** by producing **Abs**
- **Professional Ag presenting cell (APCs)** → ⊕ Th cells

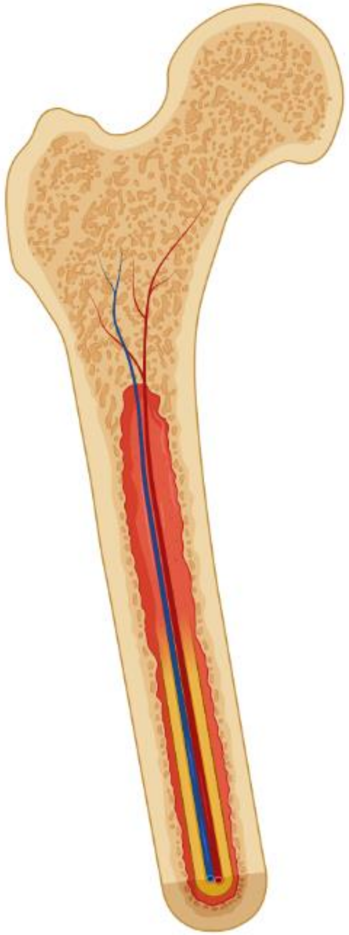


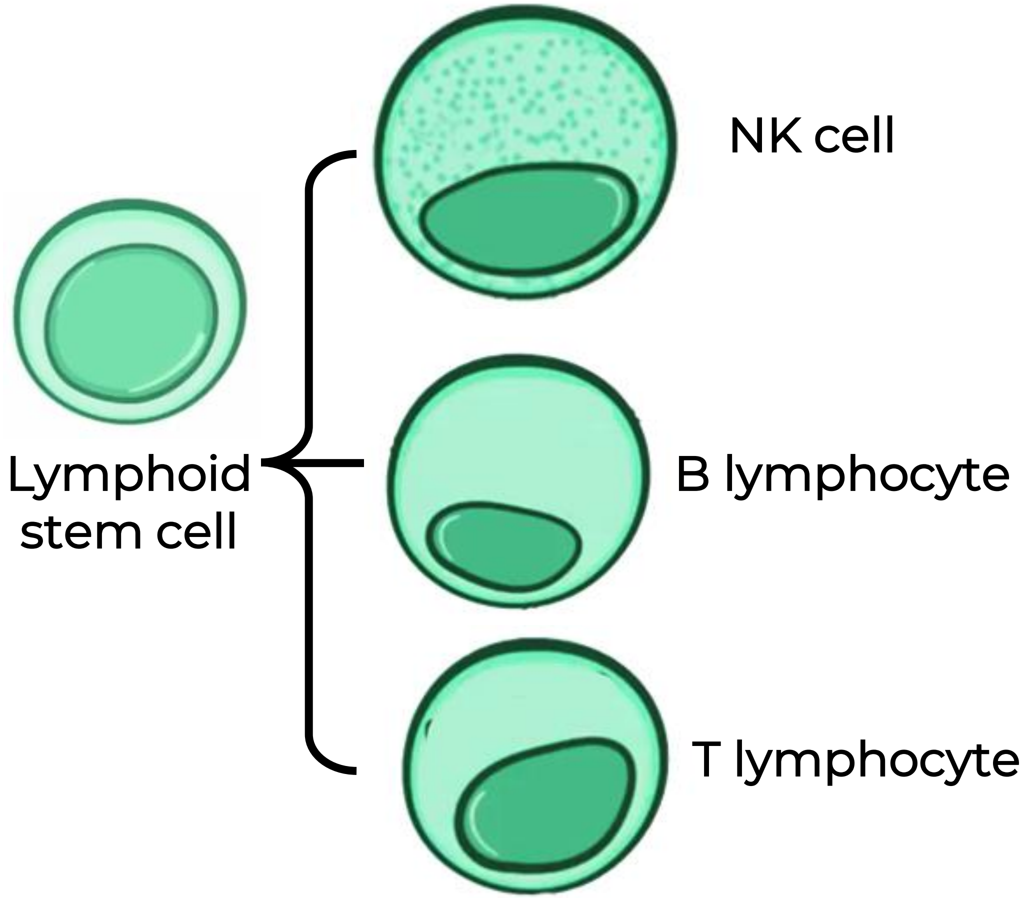


B lymphocytes

Origin & maturation

B-cells arise from lymphoid **stem cells** in **bone marrow** & mature in **bone marrow**

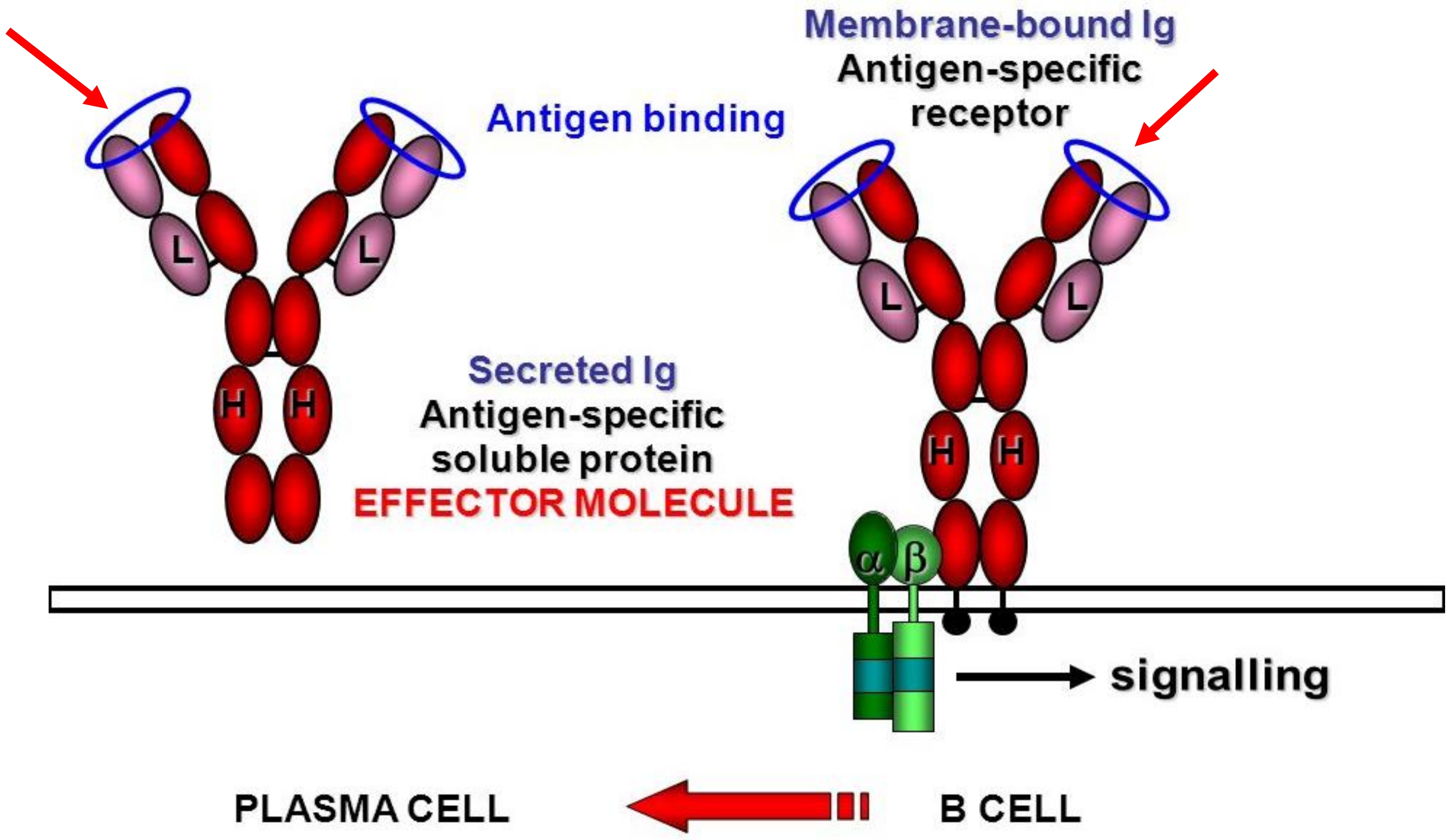




Forms of antibodies

1) Membrane bound : Ag receptor on B cell surface (BCR)

2) Secreted : Produced from plasma cells



B lymphocytes

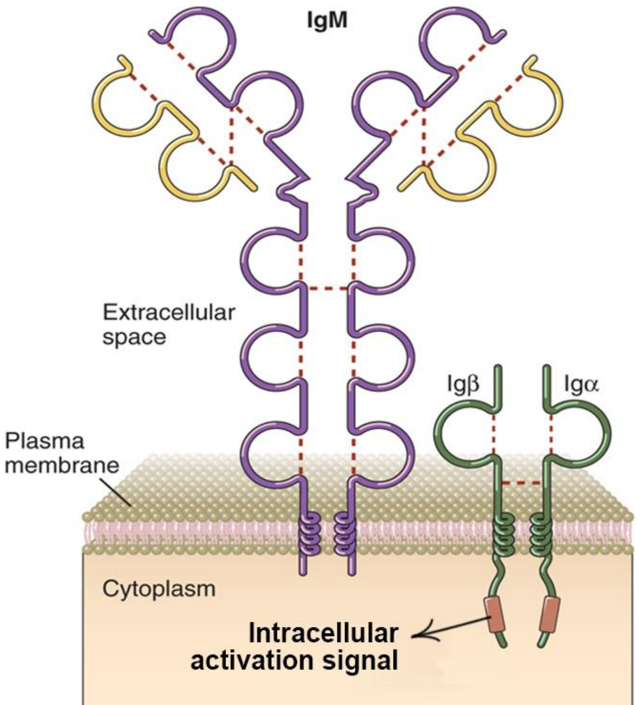
B Cell receptor (BCR) complex

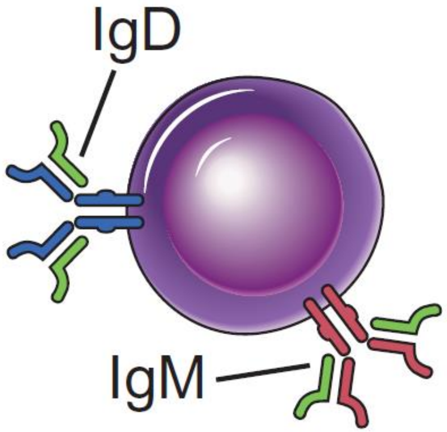
A Structure

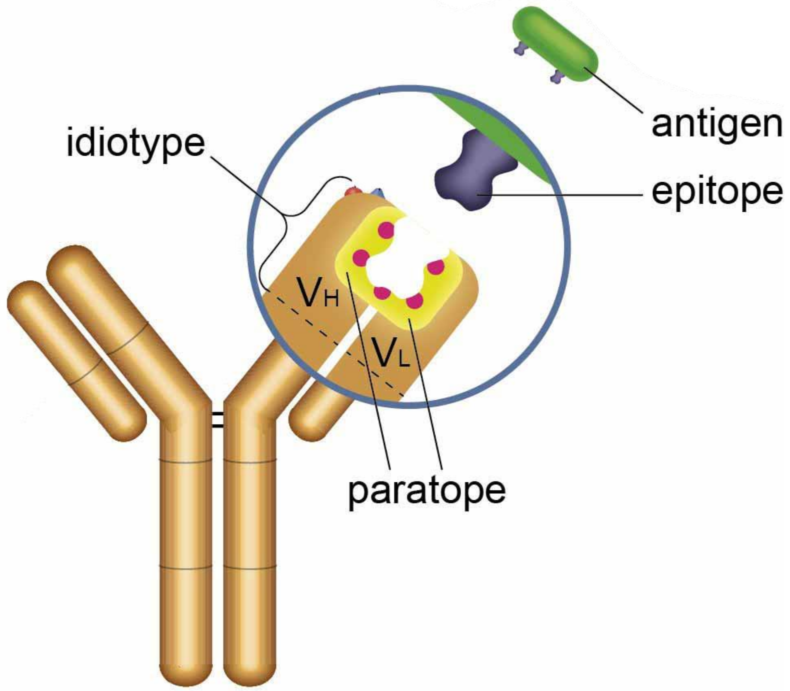
1) **BCR:** **surface** (membrane bound) **IgM & IgD**

V (variable) region recognizes **specific epitope** (complementary to it)

2) **2 signaling molecules: Igα & Igβ** → Transmit **IC activation signal**





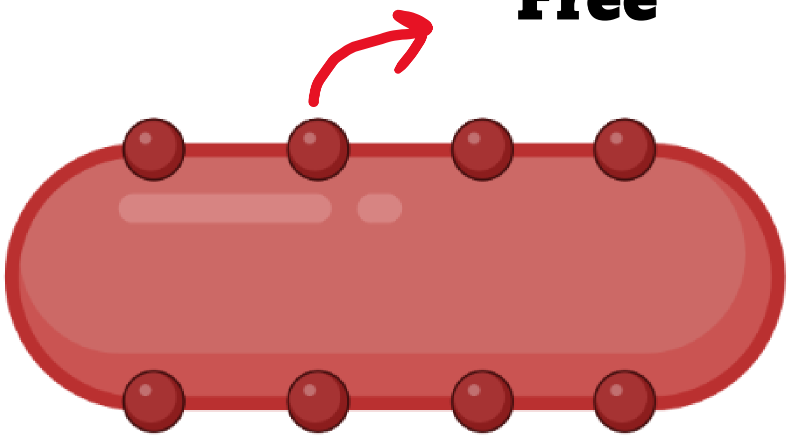


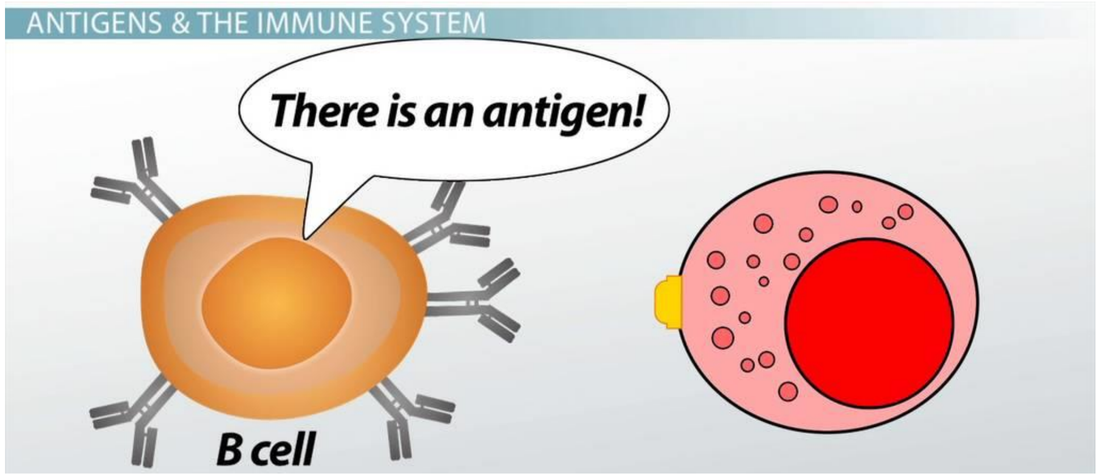
Ag recognition by BCR

soluble

Native form

Free





- BCR recognizes Ag directly without :

processing ,

or MHC molecules

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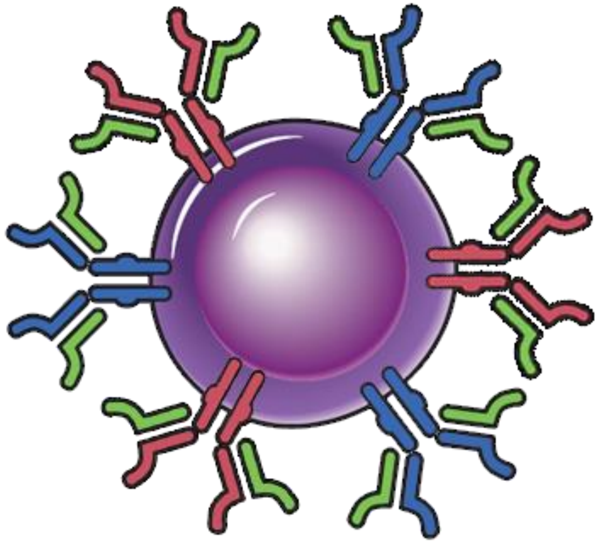
B cell doesn’t need Ag presenting cells (APCs)

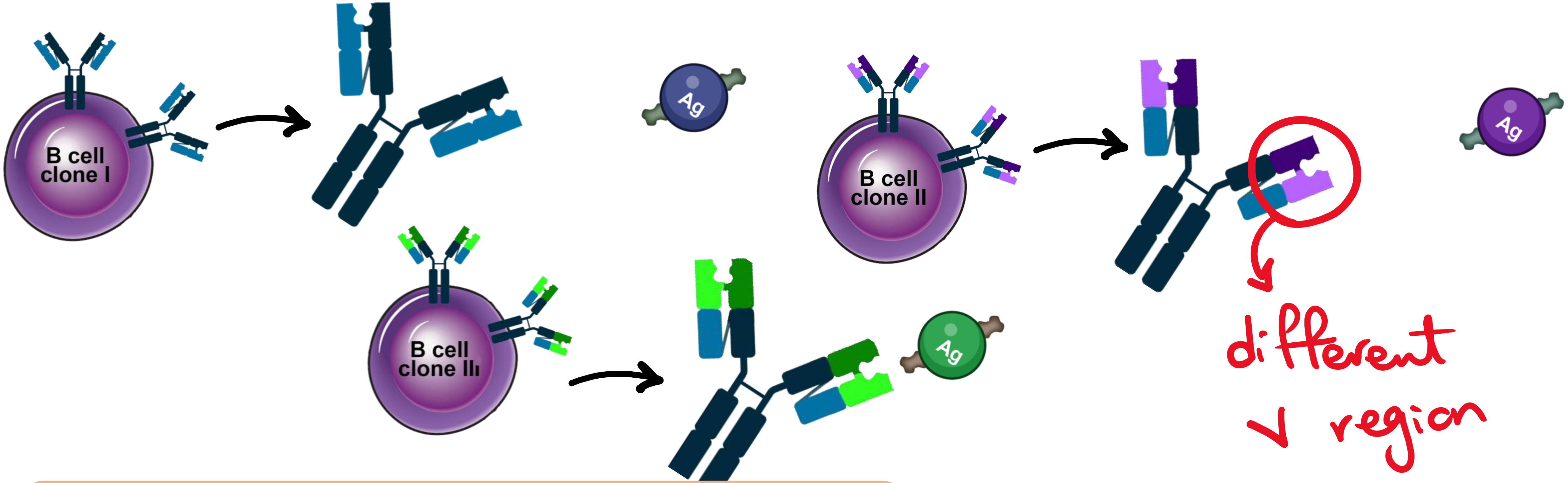
- BCR recognizes proteins, polysaccharides & DNA



B Diversity

- Each B cell clone **expresses BCR (variable region) specific for 1 epitope**

➡ Millions of B cell clones that can react with **millions of different epitopes**



different V region

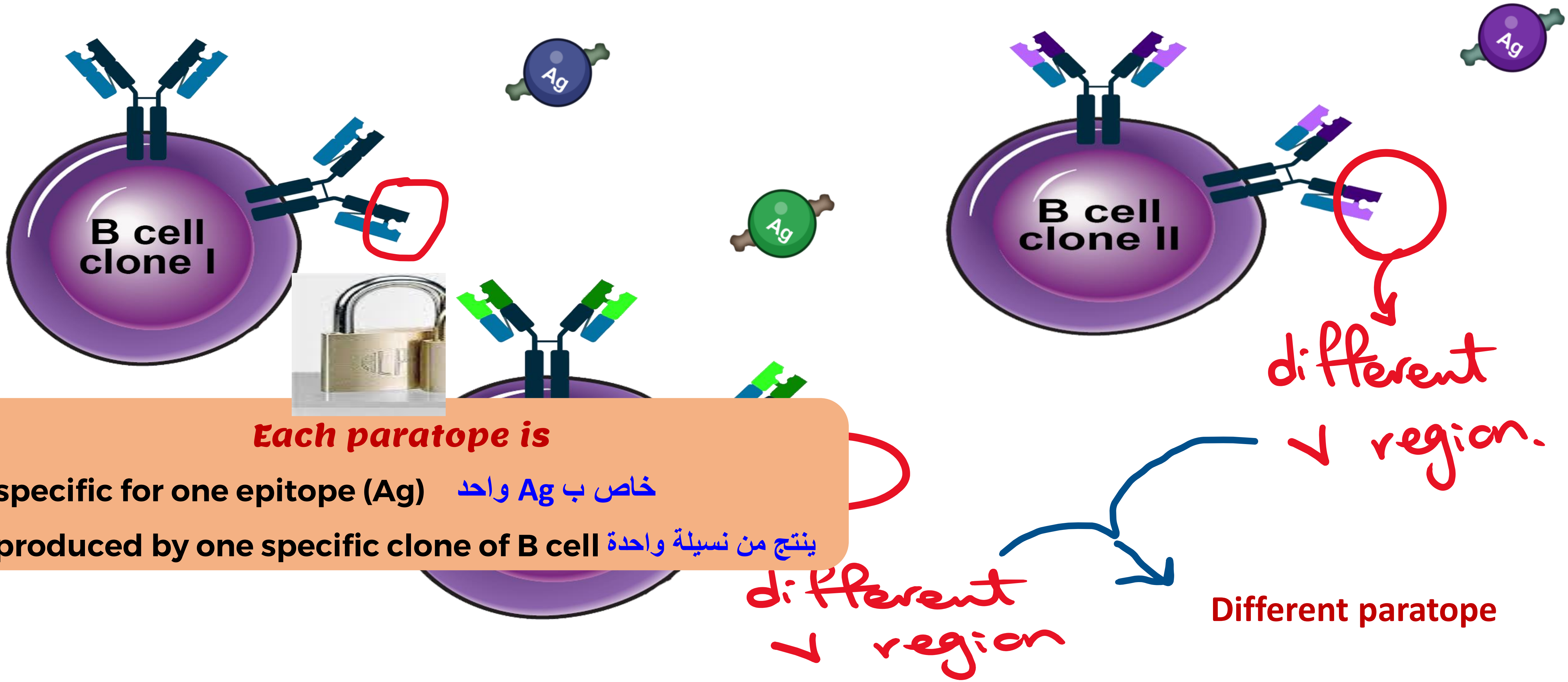
Each paratope is

- **specific for one epitope (Ag)**
- **produced by one specific clone of B cell**

B Diversity & Specificity

- Each B cell clone **expresses BCR (variable region) specific for 1 epitope**

➥ Millions of B cell clones that can react with **millions of different epitopes**



Each paratope is

- specific for one epitope (Ag) خاص ب Ag واحد
- produced by one specific clone of B cell ينتج من نسيلة واحدة

Quiz

Which of the following recognizes Ag on the B cell surface?

A. Igα

B. Igβ

C. CD3

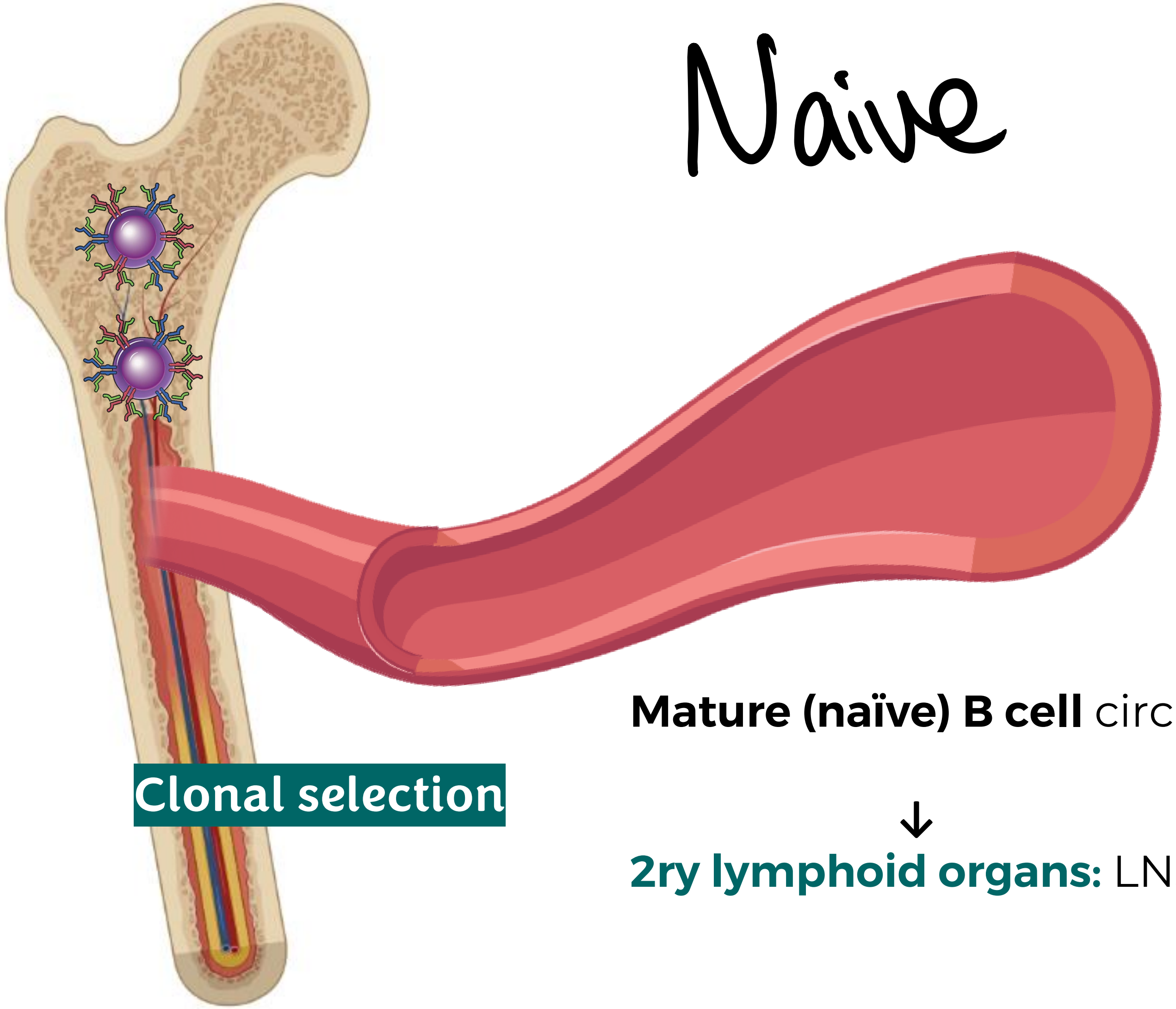
D. V α

E. IgD

D

B lymphocytes

Release & Sites

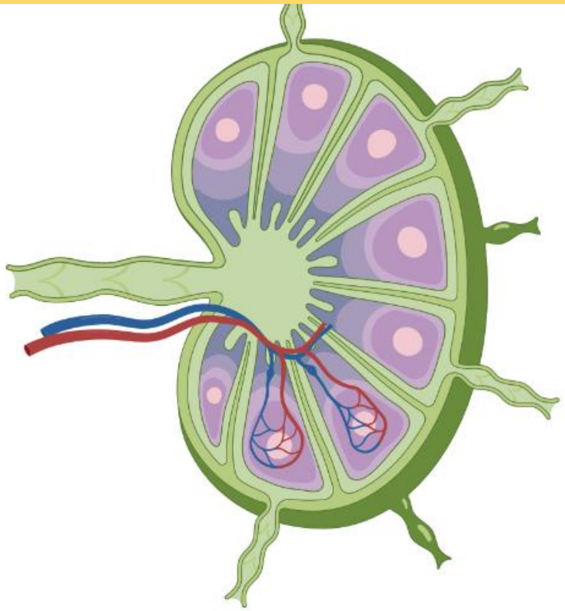


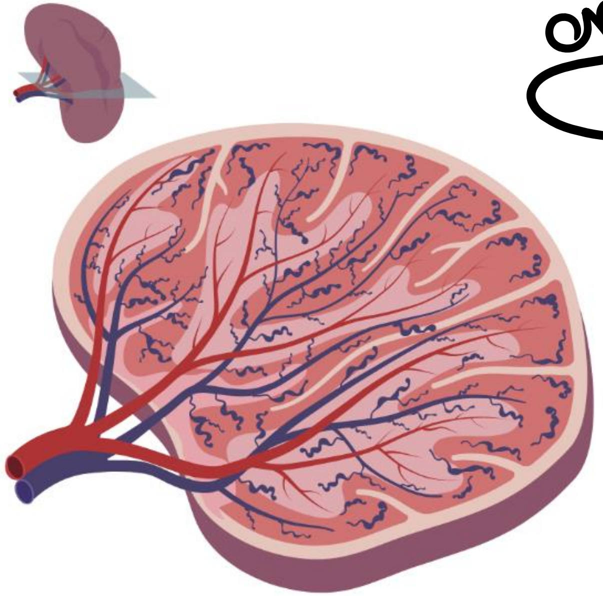
Naive

Mature (naïve) B cell circulate in blood

↓

2ry lymphoid organs: LNs, spleen





2ry lymphoid organs

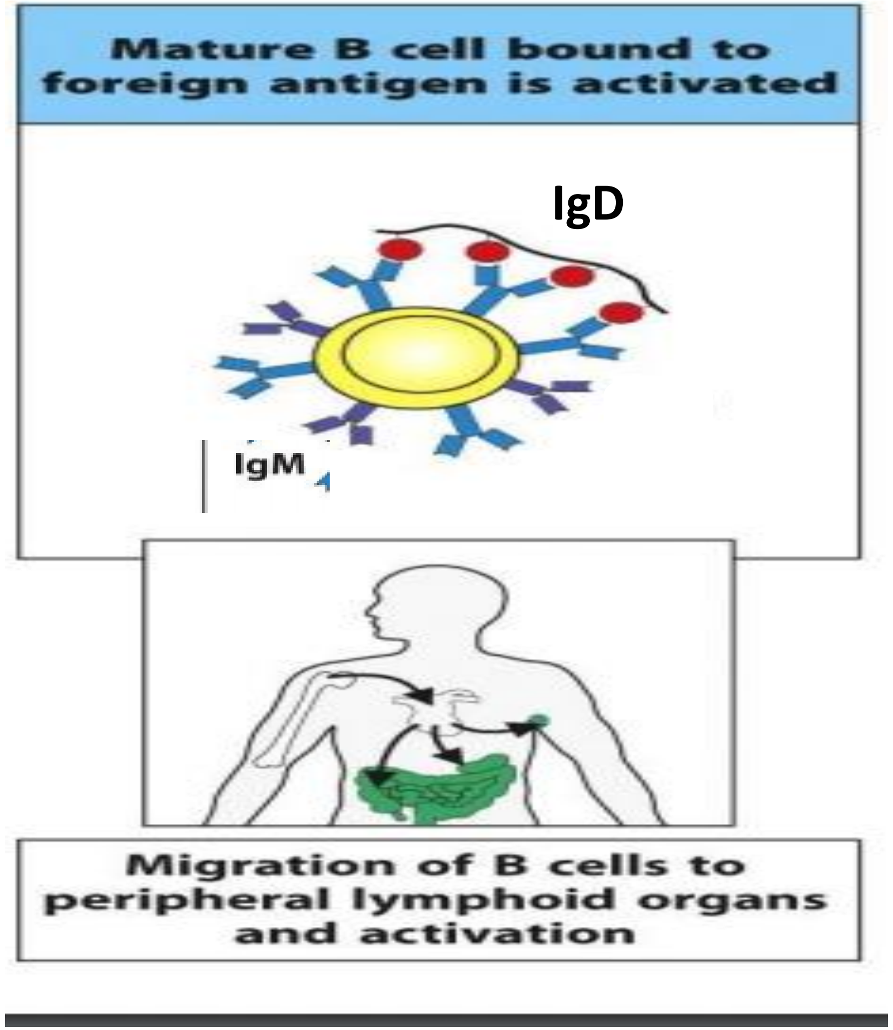
B lymphocytes

Release & Sites

Mature (naïve) B cell circulate in blood

↓

2ry lymphoid organs: LNs, spleen


Mature B cell bound to foreign antigen is activated
IgD
IgM
Migration of B cells to peripheral lymphoid organs and activation